

WHAT IS CLAIMED IS:

1. A method for analyzing noise in a digital circuit which incorporates a digital IC, a passive circuit, and a transmission line, said method comprising the steps of:

obtaining the transfer function of said digital circuit based on the circuit constants of an equivalent circuit of said digital IC constituted of passive components; the circuit constants of said passive circuit; and the circuit constants of said transmission line;

expanding an input signal to be supplied to said digital circuit into a sine wave series by Fourier expansion;

obtaining a frequency-domain output spectrum of said digital circuit from the transfer function of said digital circuit and the Fourier-expanded input signal; and

transforming said frequency-domain output spectrum into a time-domain output waveform by an inverse Fourier transformation.

2. A storage medium storing a program for controlling a computer for analyzing noise in a digital circuit which incorporates a digital IC, a passive circuit, and a transmission line, said program comprising the steps of:

obtaining the transfer function of said digital circuit
from the circuit constants of an equivalent circuit of said
digital IC constituted of passive components; the circuit
constants of said passive circuit; and the circuit constants
5 of said transmission line;

expanding an input signal to be supplied to said
digital circuit into a sine-wave series by Fourier
expansion;

obtaining a frequency-domain output spectrum of said
10 digital circuit from the transfer function of said digital
circuit and said sine-wave series; and

transforming said frequency-domain output spectrum into
a time-domain output waveform by inverse Fourier
transformation.

3. An apparatus for analyzing noise in a digital
circuit which incorporates a digital IC, a passive circuit,
and a transmission line, said apparatus comprising:

first input means for inputting the circuit constants
5 of an equivalent circuit of said digital IC constituted of
passive components;

second input means for inputting the circuit constants
of said passive circuit;

third input means for inputting the circuit constants
10 of said transmission line;

first operation means for obtaining the transfer
function of said digital circuit from said circuit constants
of said equivalent circuit of said digital IC, said circuit
constants of said passive circuit, and said circuit
15 constants of said transmission line;

second operation means for expanding an input signal to
be supplied to said digital circuit into a sine-wave series
by a Fourier expansion;

third operation means for obtaining a frequency-domain
20 output spectrum of said digital circuit from the transfer
function of said digital circuit and said sine-wave series;
and

fourth operation means for transforming said frequency-
domain output spectrum into a time-domain output waveform by
25 an inverse Fourier transformation.

4. An apparatus for analyzing noise in a digital
circuit according to Claim 3, further comprising:

first storing means for storing the circuit constants
of respective equivalent circuits of a plurality of digital
5 ICs,

whereby the circuit constants of a digital IC selected
from said plurality of digital ICs are readable out from
said first storing means to be input to said first operation
means.

10

5. An apparatus for analyzing noise in a digital circuit according to Claim 4, further comprising:

calculation means for calculating the circuit constants of said transmission line from the line width and line length of a pattern formed on a wiring board, substrate thickness, and substrate material, the calculated circuit constants being input to said first operation means.

6. An apparatus for analyzing noise in a digital circuit according to Claim 3, further comprising:

calculation means for calculating the circuit constants of said transmission line from the line width and line length of a pattern formed on a wiring board, substrate thickness, and substrate material, the calculated circuit constants being input to said first operation means.

7. An apparatus for analyzing noise in a digital circuit according to any one of Claims 3 to 6, further comprising:

second storing means for storing the circuit constants of a plurality of passive circuits,

whereby the circuit constants of a passive circuit selected from said plurality of passive circuits are

readable out from said second storing means to be input to the first operation means.

10

8. An apparatus for analyzing noise in a digital circuit according to Claim 7, further comprising:

a display for displaying passive circuit characteristics when selecting one of said plurality of passive circuits.

5

9. An apparatus for analyzing noise in a digital circuit according to Claim 8, wherein said display further displays the frequency-domain output spectrum obtained by said third operation means and the time-domain output waveform obtained by said fourth operation means.

10

10. An apparatus for analyzing noise in a digital circuit according to Claim 9, wherein said display simultaneously displays the results of a plurality of simulations performed for different transfer functions.

15

11. An apparatus for analyzing noise in a digital circuit according to Claim 9, wherein said display further displays the impedance-frequency characteristics of said digital circuit.

5

12. An apparatus for analyzing noise in a digital circuit according to Claim 11, wherein said display simultaneously displays the results of a plurality of simulations performed for different transfer functions.

10

13. An apparatus for analyzing noise in a digital circuit according to Claim 7, further comprising:

a display for displaying the frequency-domain output spectrum obtained by said third operation means and the time-domain output waveform obtained by said fourth operation means.

14. An apparatus for analyzing noise in a digital circuit according to Claim 13, wherein said display simultaneously displays the results of a plurality of simulations performed for different transfer functions.

15. An apparatus for analyzing noise in a digital circuit according to any one of Claims 3 to 6, further comprising:

a display for displaying the frequency-domain output spectrum obtained by said third operation means and the time-domain output waveform obtained by said fourth operation means.

30

16. An apparatus for analyzing noise in a digital circuit according to Claim 15, wherein said display simultaneously displays the results of a plurality of simulations performed for different transfer functions.

17. An apparatus for analyzing noise in a digital circuit according to Claim 15, wherein said display further displays the impedance-frequency characteristics of said digital circuit.

18. An apparatus for analyzing noise in a digital circuit according to Claim 17, wherein said display simultaneously displays the results of a plurality of simulations performed for different transfer functions.

19. An apparatus for analyzing noise in a digital circuit according to Claim 3, further comprising:

printing means for simultaneously printing input information regarding the transfer function of said digital circuit, and the result of simulation.

20. An apparatus for analyzing noise in a digital circuit which incorporates a digital IC, a passive circuit, and a transmission line, said apparatus comprising:

a first interface which receives the circuit constants
5 of an equivalent circuit of said digital IC constituted of
passive components;

a second interface which receives the circuit constants
of said passive circuit;

a third interface which receives the circuit constants
10 of said transmission line;

a first operation unit which obtains the transfer
function of said digital circuit from said circuit constants
of said equivalent circuit of said digital IC, said circuit
constants of said passive circuit, and said circuit
15 constants of said transmission line;

a second operation unit which expands an input signal
to be supplied to said digital circuit into a sine-wave
series by a Fourier expansion;

a third operation unit which obtains a frequency-domain
20 output spectrum of said digital circuit from the transfer
function of said digital circuit and said sine-wave series;
and

a fourth operation unit which transforms said
frequency-domain output spectrum into a time-domain output
25 waveform by an inverse Fourier transformation.

21. An apparatus for analyzing noise in a digital
circuit according to Claim 20, further comprising:

a first store containing the circuit constants of
30 respective equivalent circuits of a plurality of digital
ICs,

whereby the circuit constants of a digital IC selected
from said plurality of digital ICs are readable out from
said first store to be input to said first operation unit.

35
22. An apparatus for analyzing noise in a digital
circuit according to Claim 21, further comprising:

a calculation unit which determines the circuit
constants of said transmission line from the line width and
40 line length of a pattern formed on a wiring board, substrate
thickness, and substrate material, the calculated circuit
constants being input to said first operation unit.

23. An apparatus for analyzing noise in a digital
45 circuit according to Claim 20, further comprising:

a calculation unit which determines the circuit
constants of said transmission line from the line width and
line length of a pattern formed on a wiring board, substrate
thickness, and substrate material, the calculated circuit
50 constants being input to said first operation unit.

24. An apparatus for analyzing noise in a digital circuit according to any one of Claims 20 to 23, further comprising:

a second store containing the circuit constants of a plurality of passive circuits,

whereby the circuit constants of a passive circuit selected from said plurality of passive circuits are readable out from said second store to be input to the first operation unit.

25. An apparatus for analyzing noise in a digital circuit according to Claim 24, further comprising:

a display which displays passive circuit characteristics when selecting one of said plurality of passive circuits.

26. An apparatus for analyzing noise in a digital circuit according to Claim 25, wherein said display further displays the frequency-domain output spectrum obtained by said third operation unit and the time-domain output waveform obtained by said fourth operation unit.

27. An apparatus for analyzing noise in a digital circuit according to Claim 26, wherein said display

15 simultaneously displays the results of a plurality of
simulations performed for different transfer functions.

28. An apparatus for analyzing noise in a digital
circuit according to Claim 26, wherein said display further
displays the impedance-frequency characteristics of said
digital circuit.

5

29. An apparatus for analyzing noise in a digital
circuit according to Claim 28, wherein said display
simultaneously displays the results of a plurality of
simulations performed for different transfer functions.

10

30. An apparatus for analyzing noise in a digital
circuit according to Claim 24, further comprising:

a display which displays the frequency-domain
output spectrum obtained by said third operation unit and
the time-domain output waveform obtained by said fourth
operation unit.

15

20

31. An apparatus for analyzing noise in a digital
circuit according to Claim 30, wherein said display
simultaneously displays the results of a plurality of
simulations performed for different transfer functions.

32. An apparatus for analyzing noise in a digital
circuit according any one of Claims 20 to 23, further
25 comprising:

a display which displays the frequency-domain
output spectrum obtained by said third operation unit and
the time-domain output waveform obtained by said fourth
operation unit.

33. An apparatus for analyzing noise in a digital
circuit according to Claim 32, wherein said display further
displays the impedance-frequency characteristics of said
5 digital circuit.

34. An apparatus for analyzing noise in a digital
circuit according to Claim 33, wherein said display
40 simultaneously displays the results of a plurality of
simulations performed for different transfer functions.

35. An apparatus for analyzing noise in a digital
45 circuit according to Claim 32, wherein said display
simultaneously displays the results of a plurality of
simulations performed for different transfer functions.

36. An apparatus for analyzing noise in a digital
50 circuit according to Claim 20, further comprising:

a printer which is capable of simultaneously printing
input information regarding the transfer function of said
digital circuit, and the result of simulation.

55 37. A method of enabling a user to select a passive
circuit, said passive circuit being included in a digital
circuit along with a digital IC and a transmission line,
comprising the steps of:

supplying said user with a program for analyzing noise
60 in said digital circuit, on the basis of circuit constants
of said digital IC, said transmission line, and said passive
circuit;

and supplying said user with circuit constants of a
plurality of passive circuits,

65 thereby enabling said user to select a passive circuit
from among said plurality of passive circuits on the basis
of an analysis result of said program.

38. A method according to claim 37, wherein said
70 program is supplied to said user on a storage medium.

39. A method according to claim 37, wherein said
program is supplied by making said program available for

75 downloading over a network.

40. A method according to claim 37, wherein said
program comprises the steps of:

80 obtaining the transfer function of said digital circuit
from the circuit constants of an equivalent circuit of said
digital IC constituted of passive components; the circuit
constants of said passive circuit; and the circuit constants
of said transmission line;

85 expanding an input signal to be supplied to said
digital circuit into a sine-wave series by Fourier
expansion;

obtaining a frequency-domain output spectrum of said
digital circuit from the transfer function of said digital
circuit and said sine-wave series; and

90 transforming said frequency-domain output spectrum into
a time-domain output waveform by inverse Fourier
transformation.

41. A method according to claim 40, wherein said
95 passive components are filters.

42. A method according to claim 37, wherein said

circuit constants are supplied to said user on a storage medium.

100

43. A method according to claim 37, wherein said circuit constants are supplied to said user by making them available for downloading over a network.